have fired "successfully" are now among the ranks of those who do not, and will not, fight frost again with the means and methods now in use. Still, one more reason for not fighting frost is presented in many places, and that is that the period of safety in the buds has not been satisfactorily settled, for, it is claimed, some buds may withstand a temperature of 26° in safety, while others on the same tree may be killed at 31°; and this question, unanswered satisfactorily to many fruit growers, has kept them from the "firing ranks."

The segregated locations of the orchards in the State, and the varying conditions in the more closely compacted fruit-growing communities up and down the air drainage slopes, presenting varying stages of development and progress in the fruit, are two reasons why community or neighborhood firing can not obtain very generally here. And the lone grower on the slope who has prepared to fire is often finally dissuaded because his neighbors will not assist him to "heat all outdoors." In many cases in Utah the grower, heating his orchard alone, has concluded it does not pay, as he watched the heat and smoke from his fires sweep down into the valley away from his orchard on a 15 or 20 mile mountain breeze, rendering his smoke and heat blanket quite ineffective over his own trees.

Another thing that deters many fruit growers from firing is the very intricacy of the problem, when conducted along strictly scientific lines. To study the air drainage of the orchard, map it for temperature pockets and windy ridges, danger zones and safety belts, then distribute pots, and fire accordingly, after making a careful study of the horticultural problems involved, and make all purchases (with the "profits" of a crop not yet borne), and manage all affairs in connection with the work, is, unfortunately, too tangled a matter for many an intelligent grower.

But, assuming the figures hereinbefore presented to be the basis for calculating all legitimate charges against the cost of frost fighting in Utah, the next query is, "How often could we have fired safely in the past; how often would we have failed; and what would it have cost?" for figures of the past weather are the only possible guide to what the future weather will be.

In an endeavor to furnish the reply to this query, in a general way, the following figures have been taken from the records of the weather, kept by cooperative observers of the United States Weather Bureau, with standard pattern instruments, at Corinne, Boxelder County, and Provo, Utah County, each representing large orchard districts. The mornings on which minimum temperatures fell below 30° are counted from April 10, the probable average date of frost danger to fruit; though if the previous few weeks were warm an earlier date has been used, and if the previous weather was cold a later date has been used. The table showing the cost of firing will be remembered in examining these tables.

Periods of frost damage in the past.

CORINNE.

1897. Firing would have been necessary 1 night, with 29° minimum, therefore the cost would have been 60 cents per acre.
1898. No damaging temperatures occurred.
1899. Firing would have been necessary 14 nights, making a total cost of $23.20 per acre for that year.
1900. No damaging temperatures occurred.
1901. Firing would have been necessary 2 nights; total cost, $2.40 per acre.
1902. Firing would have been necessary 4 nights; total cost, $4.40 per acre.
1903. Firing would have been necessary 6 times; total cost, $12 per acre.
1904. No damaging temperatures occurred.
1905. Firing would have been necessary once; total cost, $1.80 per acre.
1906. Firing would have been necessary once; total cost, $1 per acre.
1907. Firing would have been necessary 4 times; total cost, $3.60 per acre.
1908. Firing would have been necessary 5 times; total cost, $3.80 per acre.
1909. Firing would have been necessary 9 times; total cost, $15 per acre.
1910. Firing would have been necessary twice; total cost, $2 per acre.
1911. Firing would have been necessary 15 times; total cost, $32.20 per acre.

PROVO.

1898. Firing would have been necessary twice; total cost, $2 per acre.
1899. Firing would have been necessary 4 times; total cost, $4.40 per acre.
1900. Firing would have been necessary 4 times; total cost, $3.60 per acre.
1901. Firing would have been necessary once; total cost, $1.40 per acre.
1902. Firing would have been necessary 4 times; total cost, $4.80 per acre.
1903. Firing would have been necessary twice; total cost, $2.40 per acre.
1904. Firing would have been necessary twice; total cost, $2.80 per acre.
1905. No damaging temperatures occurred.
1906. Firing would have been necessary once; cost, $1.40 per acre.
1907. Firing would have been necessary 5 times; total cost, $7 per acre.
1908. Firing would have been necessary 4 times; total cost, $6 per acre.
1909. Firing would have been necessary 8 times; total cost, $14.40 per acre.
1910. Firing would have been necessary 3 times; total cost, $7 per acre.
1911. Firing necessary 3 times before the fruit was lost; total cost, $10.20 per acre, and the crop was lost.

WHY THE SNOW SLIDES FROM THE MOUNTAIN SLOPES.

By J. CECIL ALTER, observer, U. S. Weather Bureau.

Snowslides and avalanches of various dimensions are quite common in the Wasatch Mountains during warm periods in winter and in the early springtime; and while it is quite apparent that when the weight of snow becomes very great on a steep slope the whole mass will be easily forced from its footing, the reason is not nearly so plausible why a broad expanse of snow having a uniform depth that has lain in apparent safety several weeks after falling will, under certain conditions of weather or internal texture, become so delicately poised that the flutter of a bird on its surface, or, as has been said, even an echo, will send several acres and thousands of tons of snow on a devastating journey down the mountain side.

From general observations it is apparent that the depth of the deposit, in itself, has very little to do with its stability or its tendency to cling to the mountain surface, for, while we hear mostly of the slides in the deeper snows, there are ample evidences that snow layers even less than a foot thick have slid from where they were originally deposited and become scattered along the lower slopes. A slide of this kind is seldom dangerous, and it is only when one inadvertently walks out on such a soft mass with web snowshoes that there is any particular danger. However, on less than a 40° slope (40° from the horizontal) and where the soil underneath is frozen, there is practically no danger of a slide even if the snow layer is 2 feet deep.

It will not be forgotten by the snowshoe mountain climber, however, that when the snow layer, even on a frozen slope of only 40°, is 3, 5, or 7 feet deep, there is probably a sharp demarcation surface somewhere in the mass, separating two falls of snow, and if the lower layer had its surface frozen before the upper layer was deposited there is grave danger of a slide of the upper layer along this surface if one walks upon it. It takes more than a bird's flutter or an echo to start a slide of this kind. A slide like this may possibly occur on a 35° slope provided it be only a short distance above a steeper slope, that is, near a ledge or a steeper declivity.

A slide of this kind can not be foreseen, and there is only one evidence of reasonable safety that presents itself, as a sign of security, and that is the protrusion of a great many shrubs, saplings, and trees through the snow. The snow very seldom slips along the ground where there are a great many small trees or saplings, and reasonable safety nearly always lies among the protruding bushes. About the only exception to this rule is where the snow surface is crusted and recent deposits of fine dry snow have accumulated in limited drifts or patches on the crust; these powdery deposits are sometimes treacherous, even among the trees, and may slip under one's weight, carrying the entire drift, perhaps an acre or more in extent, down the slope to be shattered among the trees.

A tendency for the entire snow layer to lose its hold and go dashing down the slope may be expected on almost any slope, timbered or bare, that is steeper than 40°, after a period of warm rainy weather. It is true, there are very few outward evidences of the downward creeping of the snow layer that will serve to warn the traveler, except that among the thinner, smaller bushes protruding through the snow layer, the bushes will have begun to lean a little; though a very slight leaning probably signifies imminent danger. Also, one may hear the occasional slumping or settling of the layer when in a dangerous region. Either of these evidences should be accepted as a warning to quickly seek flatter and safer territory.

Business taking one into the mountains where there are many long steep slopes carrying several feet of snow must be very important to justify the risk, if there have been a few days of unusually warm weather, with perhaps some rain; for such weather conditions are sure to cause the melting snow and the falling rain to leach down through the snow layer and break up its texture, leaving it a heavy, mushy, insecure mass, or, to use the common expression for this condition, the snow is "rotten." A great weight of this kind of snow, eaten full of vertical and criss-cross drain seams, and no longer held together in a tough, tenacious body, is very insecure and is especially dangerous if the ground and surface leaves and shrubbery underneath are unfrozen, and are wet and slippery from the snow drainage. Conditions of this kind are readily detected by alpenstock examinations and by the supporting strength of the snow.

Most of the heavier avalanches, judging from old avalanche trails in the bent and broken timber, go down the ravines and gullies. These natural drainways are often quite steep sided and deep, and when filled to the level of the adjacent regions with heavy, rotten snow, having in them very little obstruction in the way of sharp curves or stones, and of course no trees, the snow appears to let go quite suddenly, without noise or warning, and go piling and crashing down the gulch. A mass of wet snow is very readily compacted under pressure into the consistency of ice, and, as the avalanche gains momentum, these ice masses can not come to rest until comparatively level land has been reached; therefore, trees and stones, and often large jutting portions of the earth, are carried away by them.

The presence of these danger-lurking ravines is always indicated by a swale in the mountain side, centering somewhere near the gully, and by the general absence of trees and shrubs directly over it, and occasionally by side cliffs showing above the snow.

In the springtime after a winter of heavy snow, when warm weather and rains are frequent, snowslides are quite numerous, though not always large, and not always reaching the bottoms. During such conditions as these the mountain traveler will find it to his interest to avoid the untimbered or bare slopes, and even the timbered slopes whose surfaces point downward more than 35° from the horizontal.

MEASUREMENT OF SNOW IN BIG COTTONWOOD CANYON, UTAH.

By SYLVESTER Q. CANNON, Assistant City Engineer, Salt Lake City, Utah.

The investigation of the source of the water supply and the probable quantity available for each season in any community is of prime importance. The matter of the supply available for Salt Lake City, particularly during the late summer, fall, and early winter is worthy of careful consideration. Among the sources from which this city derives its water supply Big Cottonwood Creek assumes considerable prominence both because of the purity of the water and the quantity discharged. Of all the streams draining into the Jordan Valley this creek has the largest run-off. Besides the water used by Salt Lake City this stream furnishes water for the irrigation of a large portion of the land on the east side of the valley, and for power purposes. Although not the largest watershed draining into the valley, the Big Cottonwood has a larger maximum flow and a more constant discharge.

With the idea in mind of obtaining information relative to the probable supply for the season, and for the purpose of making comparisons of conditions from year to year, the measurement of the snow in Big Cottonwood Canyon was instituted in April of this year. It was undertaken by the engineering department of Salt Lake City, with the advice and cooperation of the local office of the United States Weather Bureau.

In commencing the work of measurement in this watershed it was found that, owing to the greater depth and density of the snow, the equipment which had been effectually used by the Weather Bureau in Maple Creek Canyon was not suitable; so special equipment was made. This consisted of a spring balance of a total capacity of 10 pounds, a jointed galvanized iron tube 2 inches in diameter, in two sections of 5 feet each, and a jointed, graduated wooden pole in two lengths of 6 feet each, shod with a sharp iron point on one end.

Big Cottonwood Canyon is characterized by a number of fairly long branches or forks draining into the main canyon from either side. Different portions of the watershed are distinguished by certain features. For instance, the forks on the north side of the canyon from the mouth up to Maxfield Gulch are very narrow, steep, and rocky, with some straggling pine timber; those from Maxfield Gulch up to Brighton Basin are more open, with gentle slopes and rolling hills covered with quaking aspen and underbrush; and practically all of those on the south side are wider, with steep slopes covered in great part with pine timber. These forks all head in a lofty ridge with peaks rising from 10,000 to 11,600 feet in elevation, which divides Big Cottonwood from Little Cottonwood watershed. In various places on the side slopes of the south forks bare spots occurred, which afforded starting points for snowslides. Most of these forks have been the scene of glacial action. In Mill B South Fork and Mill F South Fork, as well as in the Brighton or Silver Lake